A Broken Shroud, A Leaky Valve, and Much, Much More

by Dr. Peter Lyman

The library was full of JPLers gathering again for another unique glimpse of the Lab. Our storyteller, Peter Lyman, former JPL Deputy Director, appearing distinguished and relaxed, began sharing memories with former colleagues as the audio crew made their final adjustments to the sound system. Among the crowd of newer employees and veterans, Larry Dumas, our retiring Deputy Director and Lyman's successor, enjoyed a few convivial minutes as story time approached.

Teresa Bailey, JPL Stories' coordinator, introduced Lyman. He is currently retired but remains active working on various consulting jobs. He was JPL's Deputy Director from 1987 until his retirement in 1992.

Lyman shared how he and Teresa Bailey had developed his story. Although they were able to arrive at a title fairly quickly, he wasn't too certain about what he would like to talk about. After mulling things over for a while, he found himself considering the fundamental element of the Lab's success.

"Well, clearly, it's the people," said Lyman. "It's not the aluminum or the fiberglass; it's not the beryllium or the resistors or things like that. But it's the people – the teams of people that we put together to do things. It's the training, what I prefer to call mentoring, of those people to make things happen. I thought when I put the title together – "A Broken Shroud, a Leaky Valve..." that I could tell you some things that happened along the way on my JPL story (and there are 15–20,000 JPL stories).

"In my story there are some defining moments. When I look back on them, it is clear that this place is run by some very bright people, but, more importantly, it is run by *teams* of very bright people. The major message I want to leave with you is the reason we can do the tough things that we've done in the past, that you're doing now, and that will be done in the future is because you have got the right people together. And you should be mentoring those people."

Destiny

Lyman related that in the late 1950s, a few years before he came to work at the Lab, he had met JPL's first director, Theodore von Kármán. Lyman was the operating engineer and design engineer for the ship model towing tank at the University of California, Berkeley. His team had to make very precise measurements, and they had been required to redesign dynamometers and measuring equipment to work in the nonlinear regime of sea motion—big waves. Lyman was faced with developing specifications for a new set of equipment. "I didn't know how to do that and so I decided to do an empirical

experiment. The tow carriage runs down this long tank, and you tow this model and measure the forces in the waves and so forth. So I set up this big contrivance of 2×6s, 2×4s, C-clamps, piano wire and miscellaneous equipment all over this tow carriage moving up and down the tank.

"One of my professors brought von Kármán into this building. Now it's a hot summer day, the tank is 200 feet long, and 8 feet wide; there is no air conditioning, and my professor turns to this guy with all this white hair around his head, and says to me, 'Tell him what you are doing.' I tried to take him to my dynamometer equipment and show him all this fancy machinery and fancy instrumentation and von Kármán said, 'I want to know what you are doing here!' pointing to the C-clamps and 2×4s and 2×6s. It made me feel a bit embarrassed, because it is a terrible looking experiment." Lyman laughed at the memory of the scene.

"The discussion went on probably for about 15 minutes, and as he turned to leave, he said, 'You are doing it exactly right!'" Lyman said he was exhilirated.

Lyman added, "Of course, I never knew then that I would go to a place where von Kármán had such an influence."

Lyman took another moment to honor the other two men who set the foundations for JPL: Bill Pickering and Eb Rechtin. He said, "Those are the three guys who architected this organization, and the rest of us have been filling in the blanks. Now, some of the blanks were tough to fill in, and sometimes you needed to rearrange the sentence and fill in some new blanks, but the architecture has been there all along."

Records Roundup

Lyman noted several pictures that were posted on the wall behind him and viewgraphs he planned to present. "These are residual from several Records Roundups," Lyman said to appreciative laughter. "A few of us were working here when Lyndon Baines Johnson was President, and one way he left a mark on the country was the Records Roundup. I don't remember the exact number, but we had to turn in something like 30 percent of our file cabinets. Larry, do you remember exactly?"

Dumas, responded with a laugh, "No."

"Larry, you're still a politician," Lyman replied, eliciting hearty laughter. "This wasn't a trivial exercise," he continued, "and the Government Accounting Office (GAO) was going to have the file cabinets counted. For the Records Roundup they came around to us engineers and said, 'You have five file cabinets—get rid of two of them.' We asked, 'Well, Boss, what do I get rid of?' 'Don't bug me, just get rid of two file cabinets.'

"This was just at the completion of Mariner C (Mariner 4) in 1965. The project had been done in-house as had all the missions up to then, except for maybe Surveyor. At this time

we were going into a new mode of doing business. We were going to do a new mission called Voyager—not the one you have grown to know and love—but the mission that became known as Viking. And this mission was going to be system-contracted.

"We all sort of said, 'If we're not going to do things in-house, we don't need all this in house documentation on Mariner, since the contractor will have all those files,' so those files went. We watched trucks leaving the Lab every day filled with file cabinets. That was in Fall 1965. In November, NASA sent a telegram: 'Stop working on Voyager. Start working on Mariners 5, 6, and 7 (5 to go to Venus, and 6 and 7 to go to Mars.) *And do them in house.*'"

When the laughter subsided, Lyman said, "Oh, yeah, Records Roundup.... Not everybody threw everything away and we were able to do those missions. And then I retired.

"I left most of my files just where they had been," Lyman said. "I left them to Larry and the Deputy's office and the TDA office. There were some things I had accumulated, and I had four or five file cabinets at home. Of course, now, with my retirement hobbies, I need file drawer space. So, each year I do a records roundup, making space for new material. Eventually, I was down to a few JPL memos, and I thought there was some value in saving these things—I didn't know what it was, though. Today, I am here and the value is I can show them, and now I can move on."

Faint of Heart Need Not Apply

Lyman said that he had spent some time looking at his records of the Mars missions and reflecting on the nature of space exploration. "The Soviets, depending on what numbers you use, depending on what you know about what they did, tried 17 times and failed 15 plus times," Lyman stated. "The U.S. has tried 13 times and failed five times. The first two U.S. failures were launch vehicle failures that occurred in the 1960s. The next three failures occurred in the 1990s, and these were spacecraft failures. I'm not going to go through the lessons learned about what happened back then, but I think the message is that this is a tough business and it takes real dedication to make these things work."

Hiring In

Lyman recalled that, as Deputy Director, one of his favorite jobs was to hand out service awards. Everyone laughed when he said that the Deputy Director hands out the 5-, 10-, and 15-year pins at von Kármán auditorium, whereas the Director enjoys a free steak with the 20- and 25-year awardees.

"The human resources folks prompt you to go down and tell the awardees something they don't know and kill some time before we hand out the awards. One of the things I liked to do there was to talk with the audience and answer questions. If they didn't want to ask

me questions, I would ask them questions. One of the questions I liked to ask was, 'How did you get to the Laboratory?' You get some outlandish stories. One person drove up and encountered the guard gate and asked, 'What's this?' 'This is JPL.' 'What do they do?' 'They build spacecraft.' 'Oh, yeah?' He walked in, got an appointment, and signed up." The audience erupted in laughter again.

"I had a teaching appointment at the University of California at Davis in 1963. This was the first year of their College of Engineering. But I had this problem: there were no students yet, and my wife (we were living in Berkeley) said we were going to keep living in Berkeley and *I* was going to *commute* to Davis. I decided to call Bill Shemandle here at the Lab and I got an offer to do one year's research, and a couple of months later I showed up. When I got here, Larry Dumas, who had been in the class behind me at Berkeley years before was in the next office—that was a surprise. But the biggest surprise was that I wasn't going to do research; instead, they made me a cognizant engineer and said, 'By the way, all the hardware and the schedules you're in charge of now are all wrong and late. Redesign it and deliver your hardware in six months.' *And I didn't know what any of that meant*."

A Broken Shroud

Lyman said that his first year was exciting as he learned how things worked at the Lab. He had helped develop hardware for Mars-bound Mariner 3 that was designed to catch the solar panels when they were deployed and then hold them in position. This hardware was integral to the deployment of the panels. Lyman said, "By that time I was working over in the SFOF, but there really wasn't very much a guy from Division 35 could do there; you only had to report that a microswitch worked and some other minor things. Then they launched Mariner 3, and you know what? the solar panels didn't deploy! I am sitting there in the midst of this operations room where there is pandemonium going on and all I can see is there is no evidence that the solar panels opened, and also there is evidence that there is no light on the panels, and a bunch of other bad things were happening. I thought, 'This is a bad day for Mrs. Lyman's son.'"

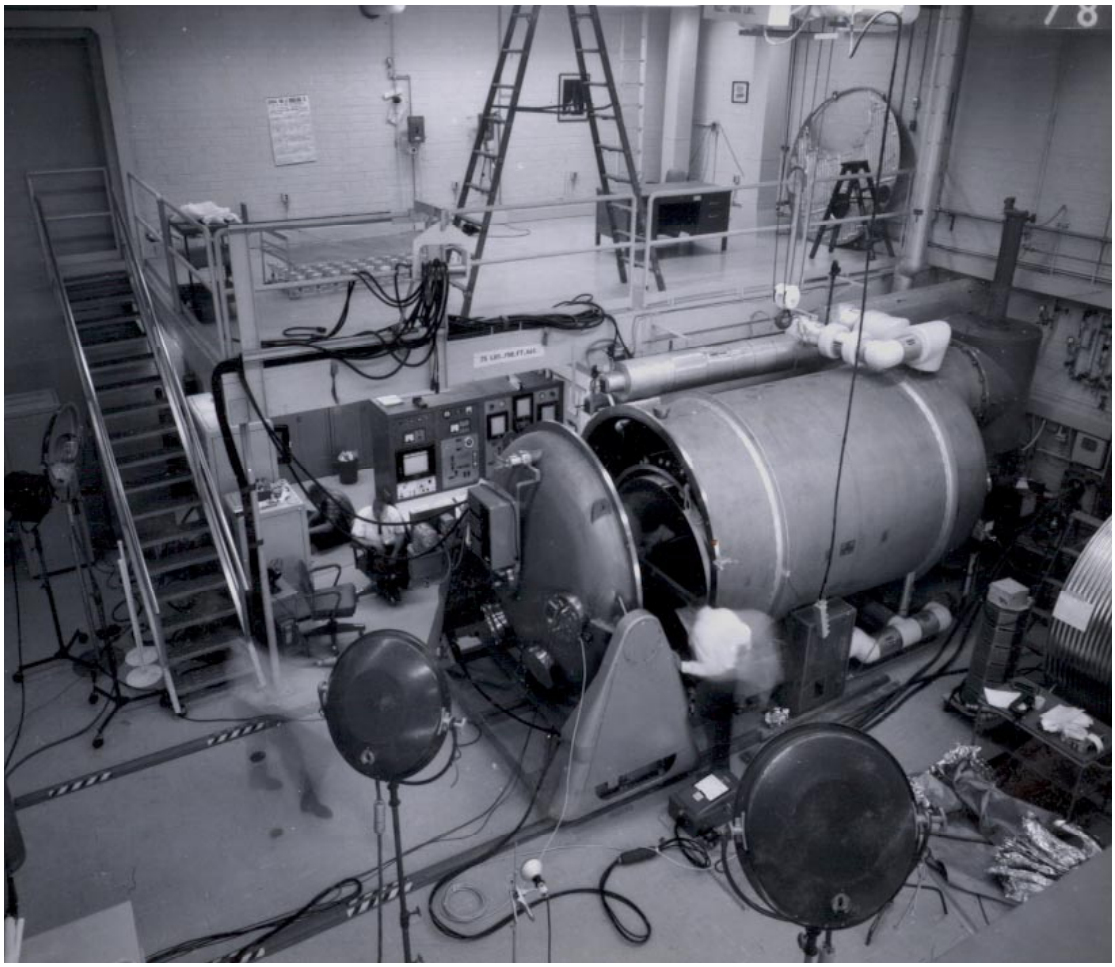
The team concluded that the shroud had not come off for some reason. Another spacecraft was available, but the problem with the shroud would have to be resolved within the 28-day launch period or the next Mars launch would have to wait another two years. The shroud was a fiberglass honeycomb structure, and there was concern that it may have come apart. Lyman knew the results of an early test of the Lockheed shroud and had observed another. Although most of the Division 35 engineers were at Cape Canaveral, Lyman and a few others were at the Lab, and they began preparing another test of the shroud.

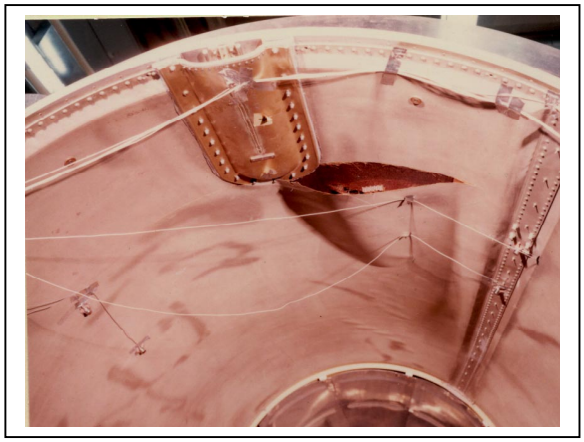
"With all this as background, we had three halves of the shroud—one whole shroud for the test from Lockheed and another half. We took the half shroud, stuck it in the vacuum chamber, pumped the vacuum chamber down, and tried heating it up to see what would

happen. There is a six-foot chamber in Building 144, and you can see some very large pipes going out of that chamber over to the wind tunnel."

"Using the wind tunnel compressors, you could pump down the pressure and then open the valve and reduce the pressure in the vacuum chamber very rapidly—you could outclimb the Atlas Aegena rocket. So we placed this half shroud inside the vacuum chamber and used some hot nitrogen to simulate heating. Don Lewis said that thermocouples should be carefully placed all around, and I said we should put some accelerometers on it also. The instrumentation people didn't agree, but I remember after a late night battle they did put three or four accelerometers on it.

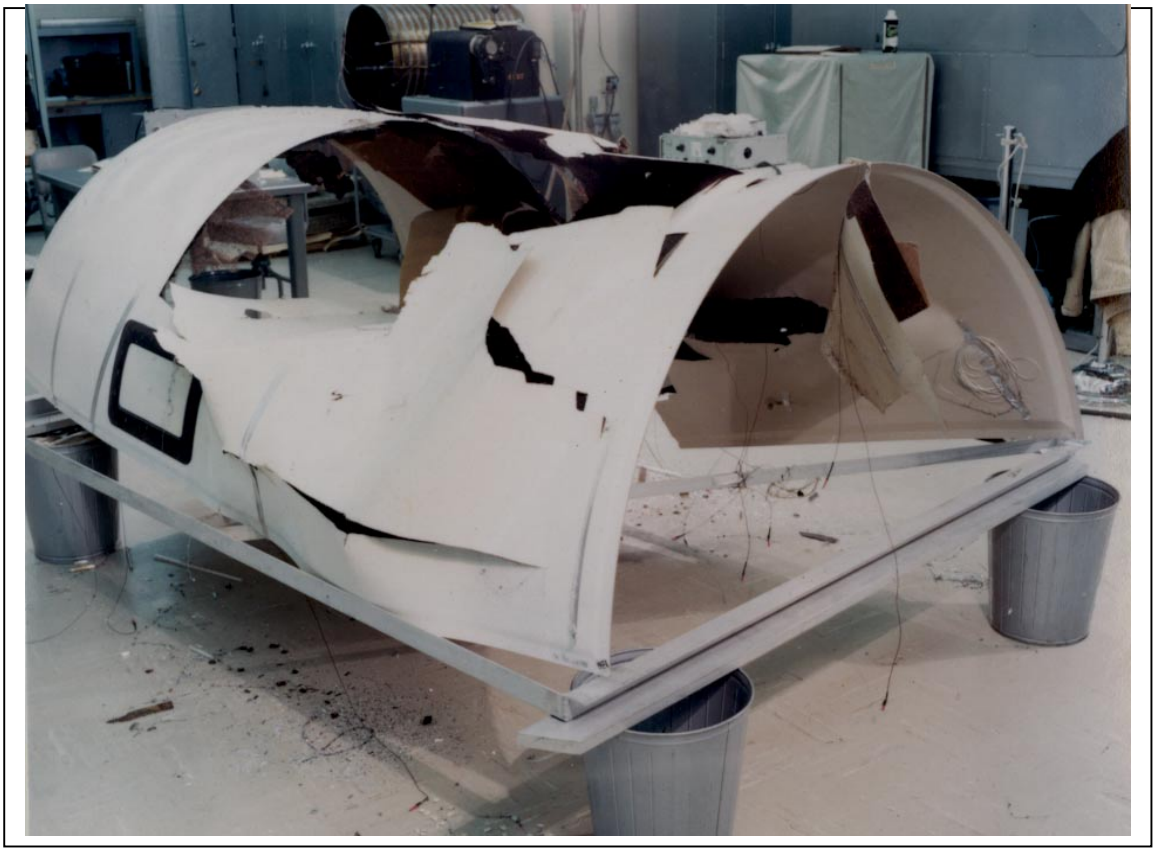
"We closed up the chamber and did the usual countdown. I was outside watching although there really wasn't anything to see. Don Lewis was in the instrumentation room watching the accelographs. Pressure's decreasing, temperature is coming up a little bit, and suddenly all the accelerographs started jumping, and I heard Don over the intercom say, 'It looks like a Jeep race in the snow.' What was happening was the fiberglass hexel arrangement was delaminating and the skin was coming off due to the pressure in the hexel sections.





"Well, now it's about 4 a.m., and we get on the phone to the Cape, and let them know what happened. They responded that Lockheed and NASA Lewis Research people said that we had used a damaged shroud and the test was meaningless. There was probably some damage; we hadn't inspected it for damage. But, anyway, we had got some people's attention, and now we started working around the clock—some of us had *sleeping bags* in our offices. Several things were happening: 1) People wanted more tests; 2) JPL was quickly coming to the conclusion that you didn't want to fly a fiberglass shroud; and 3) NASA Lewis Research Center wanted it to fly; they wanted to use it on future missions.

"So we ran a test to end all tests."



When the laughter died down, Lyman continued. "You see a lot of quartz lights, tubular lamps from Cleveland, Ohio; we flew in a lot of stuff. We set up real heating in that chamber. We heated it up, and pumped it down—*and that shroud came apart*. Is that a completely fair test? I don't know, but it helped kill off the fiberglass shroud.

"When the people did the power spectral analysis of the energy in the accelerometers, we got a nice power spectral plot; so that was interesting. Jim Maclay, who was the environmental requirements engineer, noticed that when the Aegena was cruising between the first and second burn, there were these funny squiggles on the baseline telemetry. So we ran a power spectral analysis of those squiggles and they matched perfectly—they had the same energy content as we had from the shroud delaminating.

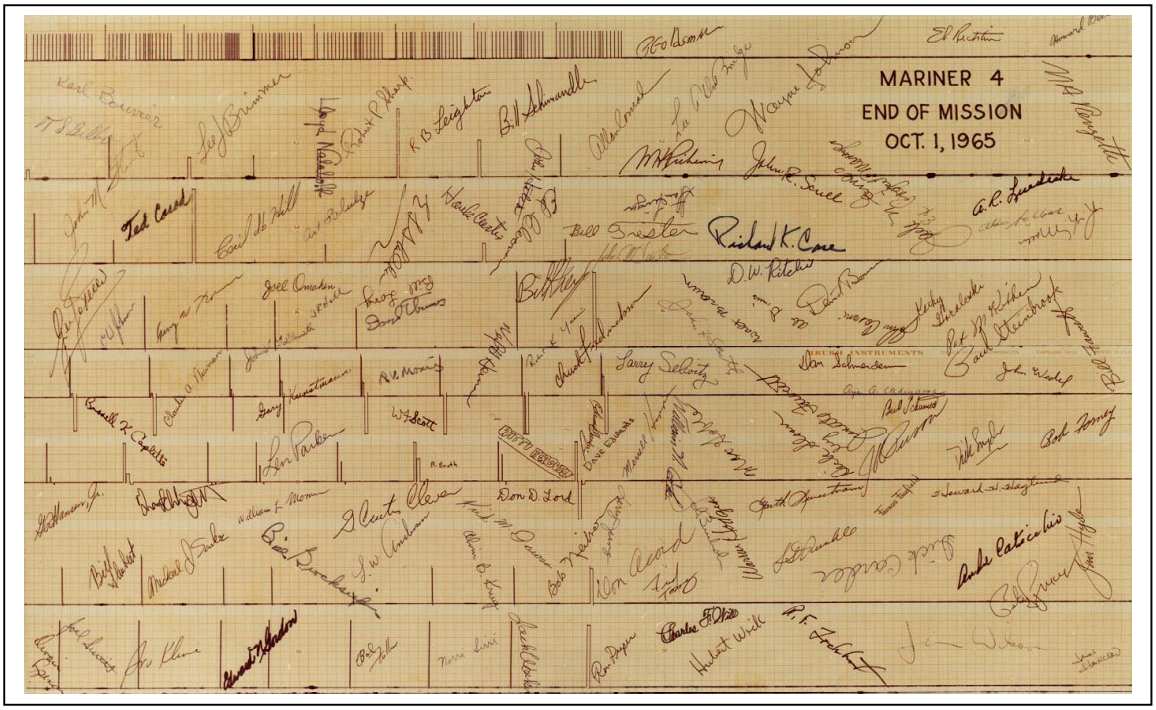
"At an early morning meeting down there with the Air Force, Lewis, Lockheed, and everybody else, (and I didn't know this until Saturday morning this week, when Jack James and I were talking about Mariner C), Jim Maclay unrolled this chart on the table and then laid out the power spectral analysis of what we had done back here. The Center Director from Lewis, who was the guy championing the fiberglass shroud, said, 'I see what you guys are telling me; the fiberglass shroud came apart.'

"He at that point directed Lockheed to build a metal shroud. But we at JPL were already building a metal shroud. In the week and a half that followed, we built a complete metal shroud, flight-qualified it, and here it is in the Building 233 high bay; we were doing separation tests.

"Ultimately the Lockheed shroud was flown for political reasons. In the picture you can see our brilliant nosecone. I had to take it off the JPL shroud and escort it down to the Lockheed skunkworks to have it put on their shroud. And so, we got the spacecraft off at the end of the launch period—that was Mariner 4, and it was very successful. This was the sharpest-pointed shroud ever built."

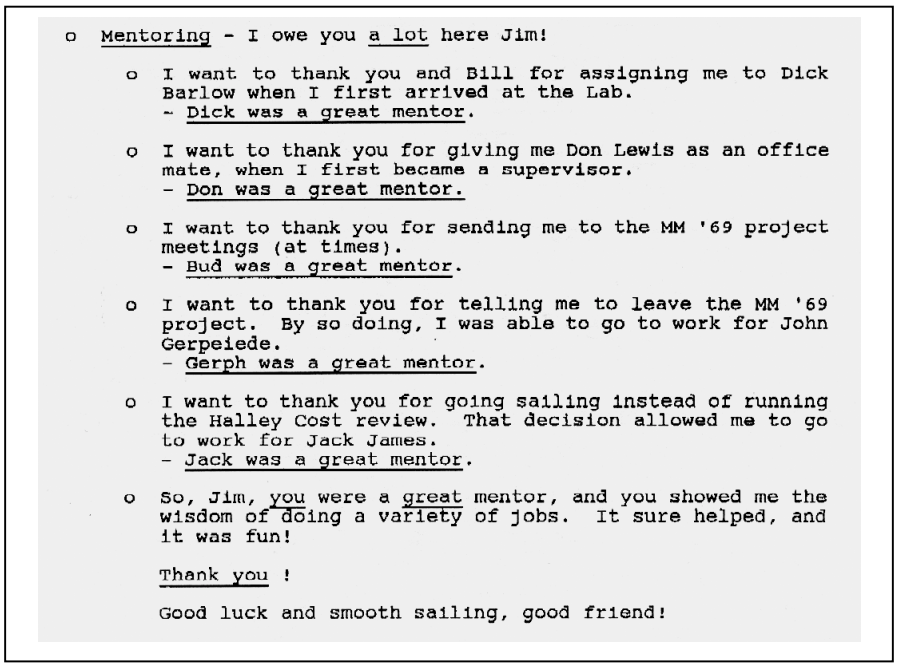
Lyman then recalled with amusement how, about a week after the meeting where the spectral charts had sealed the fate of the fiberglass shroud: “An Air Force guy was looking at the charts and exclaimed, ‘What? Those bumps on the telemetry? They’re there *24 hours a day*! We already know that stuff comes from Antigua tracking station!” Once again, the audience shared a big laugh together.

“I think it was that effort that convinced me that I didn’t want to go back and teach, that I wanted to stay here at JPL. There was a group of us that lived in our offices for a good part of two weeks and flew up and down the coast. I met John Gerpeiede during that period; I got to work closely with Jack James during that period, and also Bob Parks. Those are some of my heroes. It truly was one of those defining moments; at least it saved the Mariner C program, because if we had flown that second fiberglass shroud it could well have come apart, too. Here is a picture at the end of mission; the last piece of telemetry from Mariner 4. We got as many of the project people that were around that day to sign it.”



Lyman said, “Out of that team there were three guys that I wanted to work for some day. I would like to tell you that I carefully planned to work for them and arranged it. I actually got pushed into working for them with little choice in the matter. They were the people that I considered my mentors.”

Here is part of a 1990 memo to Jim Wilson that expressed Lyman's appreciation for his mentors.



- Mentoring - I owe you a lot here Jim!
  - I want to thank you and Bill for assigning me to Dick Barlow when I first arrived at the Lab.
    - Dick was a great mentor.
  - I want to thank you for giving me Don Lewis as an office mate, when I first became a supervisor.
    - Don was a great mentor.
  - I want to thank you for sending me to the MM '69 project meetings (at times).
    - Bud was a great mentor.
  - I want to thank you for telling me to leave the MM '69 project. By so doing, I was able to go to work for John Gerpeiede.
    - Gerph was a great mentor.
  - I want to thank you for going sailing instead of running the Halley Cost review. That decision allowed me to go to work for Jack James.
    - Jack was a great mentor.
  - So, Jim, you were a great mentor, and you showed me the wisdom of doing a variety of jobs. It sure helped, and it was fun!

    Thank you !

    Good luck and smooth sailing, good friend!

The Customer Is King

Lyman then shared a few thoughts about customer relations. "Here is a piece of history that I think bears on people here at JPL today. It is a memo marked 'Executive Council Discreet', but since it dates from 1966, I don't know whether the 'Ninth Floor' can beat up on me or not."

"It is a memo from Jack James to Bill Pickering and General Luedecke. JPL didn't want to projectize anything; we just loved our matrix system. But Headquarters— this is the customer talking to JPL—said to projectize it. It goes on with some more of Jack James' 'isms.' (I wasn't in the Director's Office; I was working on the project and I didn't have this memo.) In retrospect, JPL didn't do very much of this. We were arrogant—well, it's easy to be arrogant when you're good, and we knew how to do these things. But the customer is putting out a pretty clear message to us. In the end Headquarters took the project away from JPL and gave it to Langley Research Center."

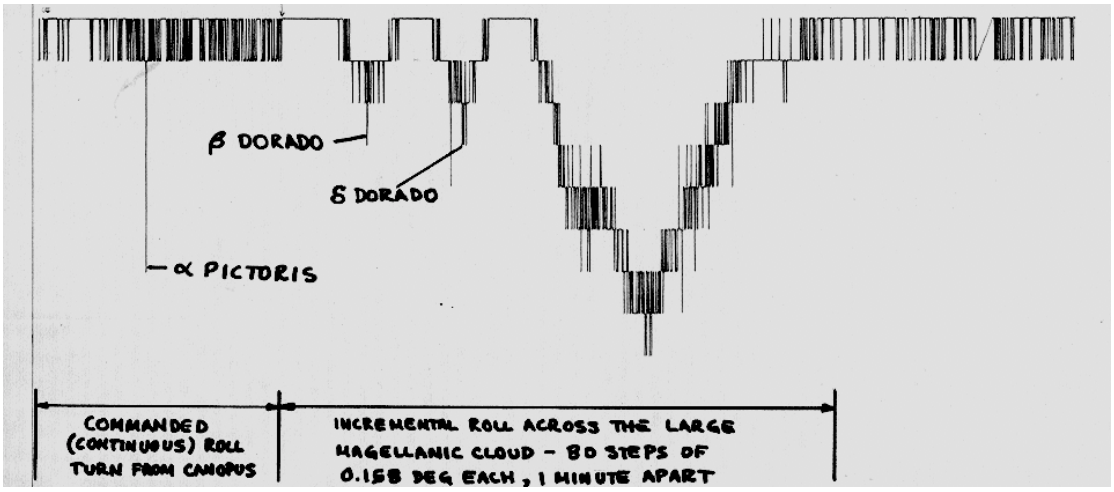
Lyman concluded, "The message of this is that there is no sense going crossways with the customer even though you may not want to do it. Good marketplace contractors like Lockheed and others spend a lot of time trying to do what the customer wants them to do. At least they listen very carefully. Government laboratories like JPL and another large one that I do consulting work for up north have a tendency not to listen, or if they do listen, they tend to ignore. I don't know which is worse."

A Minor Miracle

Lyman said that after Mariner 4 he was asked to organize and lead the flight team for Mariners 6 and 7. Of the numerous problems during those missions, he most remembered the "Canopus Star Tracker Problem."

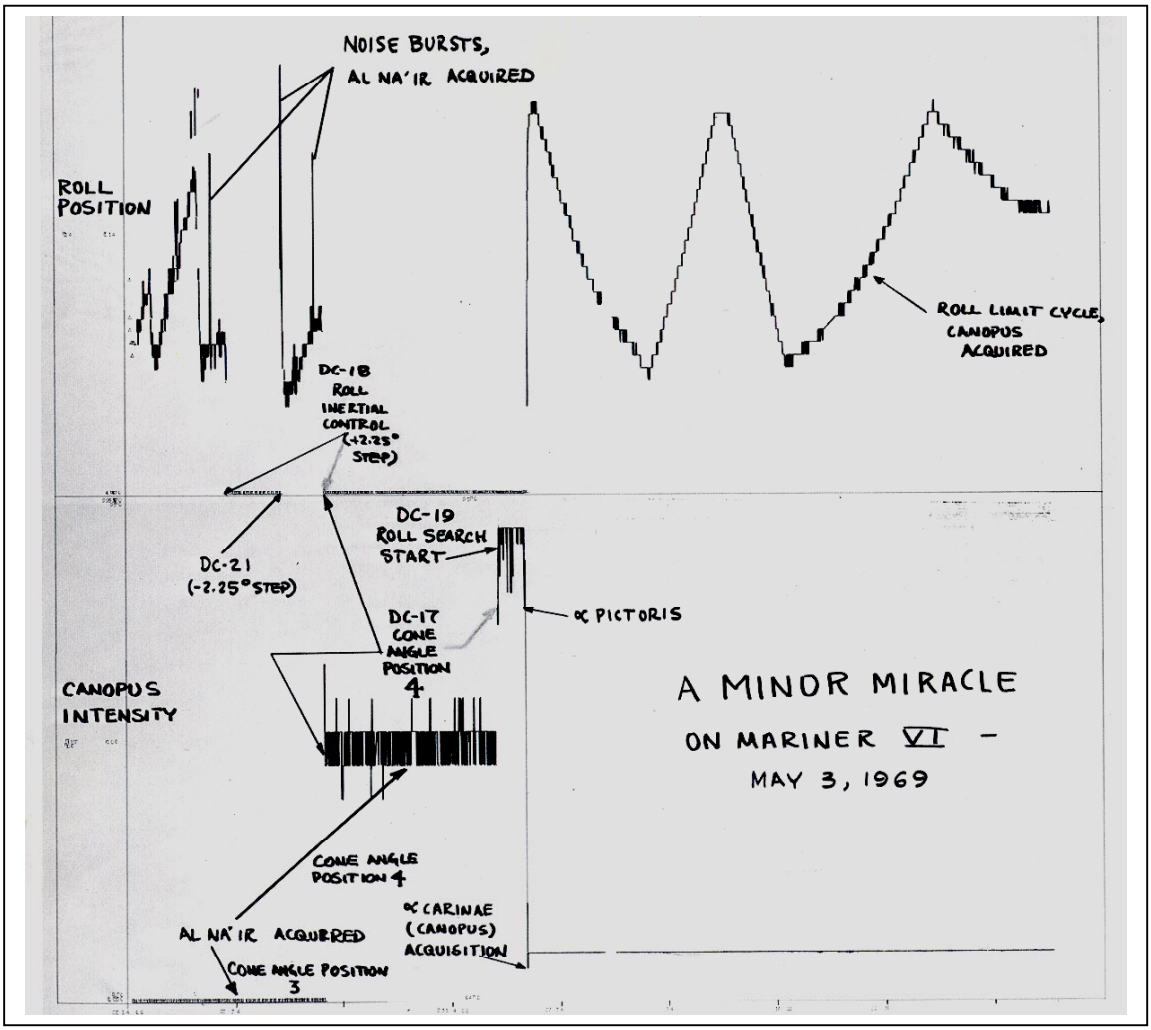
The Mariner 6 Canopus star tracker field of view relied on a free relay cutthroat counter circuit to step cone angles. It was called "cutthroat," because if a contact got dirty then the entire system would fail. "As you go around the Sun, Canopus is off the South Celestial Pole, and so you actually have to step the tracker, depending where you are around the Sun, to different cone angles," said Lyman. "Early in the mission we had to step from cone angle 3 to cone angle 4, but the step didn't occur. We commanded it and commanded it, but it wouldn't change. We analyzed and analyzed, and commanded it again, but it wouldn't change. Nothing happened. The conclusion was that it wasn't going to work.

"Now if you can't lock onto Canopus when you get around the Sun to Mars, you're in big trouble, because you don't have the correct roll orientation for the spacecraft. There were big decisions like: maybe we could use something other than Canopus. Without going through the technical details, we mapped out the Magellanic Cloud and some other stars (Beta Dorado, Gamma Dorado, and Alpha Pictoris), but none of those were good enough for roll control. We tried the Magellanic Cloud, but if you have ever seen it through a telescope, it is a big fuzzy area."



The Large Magellanic Cloud as Mapped by Mariner VI Canopus Star Tracker – May 2, 1969

"We were doing some more mapping of stars the next day and we were trying to figure out if we were possibly going to get any science data when we got to Mars, and we decided to send some more commands just to see if anything would happen with the relay circuit. We sent a command—and it stepped to position 4! That isn't the position we wanted to be in, but that's the one we wanted to be in for encounter! That's why we called it the minor miracle. We don't know why it stepped, but we never sent the command again—it was right where we needed it for encounter."


NOISE BURSTS,
AL NA'IR ACQUIRED
ROLL POSITION
ROLL LIMIT CYCLE, CANOPUS ACQUIRED
DC-18 ROLL INERTIAL CONTROL (+2.25° STEP)
DC-19 ROLL SEARCH START
DC-21 (-2.25° STEP)
DC-17 CONE ANGLE POSITION 4
∝ PICTORIS
CANOPUS INTENSITY
A MINOR MIRACLE
ON MARINER VI -
MAY 3, 1969
CONE ANGLE POSITION 4
∝ CARINAE (CANOPUS) ACQUISITION
AL NA'IR ACQUIRED
CONE ANGLE POSITION 3

Noteworthy Memoranda

Lyman next shared mementos of his days working for Jim Martin as the Viking Orbiter System Project Engineer. "This was an exalted position in my view," said Lyman. "I spent a fair amount of time trying to figure out what it was I was supposed to be doing. The only memo I saved from those days was written by a fellow named Eb Rechtin."

"That is page 1 of the memo that, from the engineering design standpoint, is one of the defining memos. This is the memo that basically gets you to the sum of adverse tolerances, for those of you that would understand that. This is the memo that defines what a design control table is. It is dated 1961, and it actually uses Mariner D (the code name for Voyager, which became Viking) as the model. It shows a sample design control table. The memo goes on for several pages in Eb Rechtin's lucid way of writing. He wanted strict control on how they were kept: the last page appoints Dick Matheson as the keeper of design control tables.

Leif Eriksson was the Viking Project mascot (shown here at Langley), not Jim Martin.

"The other defining paperwork about system engineering is: No job is complete until the paperwork is done. And its corollary, just about the time you think the paperwork is done: Hail! I bring thee changes from the chiefs!) You have to learn there is more than one boss around here." The audience laughed again in appreciation of this cogent observation.

TO: Section Chiefs, Group Leaders and Engineers of Division 33 — March 20, 1961

FROM: E. Rechtin

SUBJECT: COMMUNICATIONS DESIGN CONTROL TABLE

I. PURPOSE

Close design control of deep space communications is important because improper assignment of margins can lead either to failure or extravagant overdesign. The difference between failure and over-extravagant design is often no more than a few decibels for deep space communications. There must be a consistency of ground rules and clear understanding of what contingencies, if any, are present in the estimates of each contributor. It is not only necessary to know the nominal design values of a particular component, it is also necessary to know the tolerances on this value. From a purely management standpoint, it is necessary to have a clear assignment of responsibility for each element of the communication system. And finally, it is necessary to have unambiguous definition of the communication system margin. The criterion for deciding whether the margin is sufficient may well be controversial, since it is based upon engineering judgment; however, the criterion itself must be clearly understood.

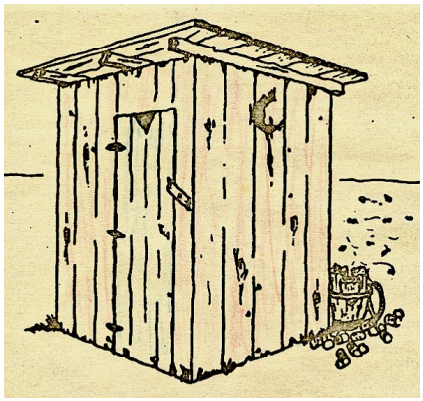
II. CONTENT OF COMMUNICATION DESIGN CONTROL TABLE

SYSTEM: Mariner D — Date: May 18, 1966

	Parameter	Nominal Design Value	Tolerance	Signature	Notes
A.	Transmitter Power	44 dbm	+1 -2 db	LWRandolph	(a)
.					
.					
.					
D.	Propagation Loss	-280 db	+0 -5 db	PDPotter	(b)
E.	Detector Threshold	- 8 db	+1 -1 db	RZToukdarian	
.					
.					
.					
K.	Signal/Threshold	10 db	+2 -8	RPMathison	

(a) Uncertainty due to lack of test data as of 16 March 1961

(b) Uncertainty due to lack of knowledge of Martian ionosphere



NO JOB IS COMPLETE UNTIL THE PAPERWORK IS DONE

HAIL! I BRING THEE MORE CHANGES FROM THE CHIEFS!

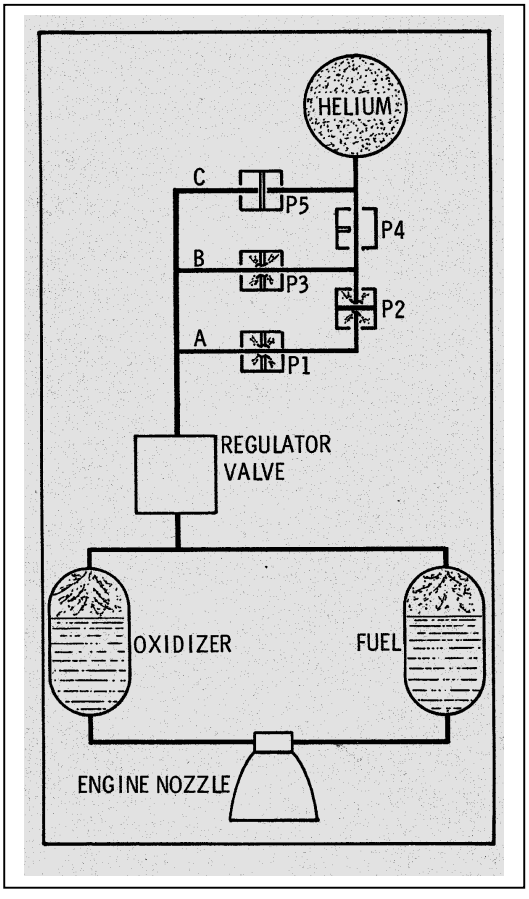
A Leaky Valve

Lyman had thought that he would return to one of the technical divisions after the Viking orbiter had been designed, but he was asked to manage the spacecraft and navigation activities for Viking that was going into operations phase. "Viking Operations was a small team of about 750 people (more laughter), of which I had 350 just doing spacecraft work and navigation."

Lyman described the general operation of the Viking propulsion system to propel the spacecraft into the correct trajectory to Mars. Since the safety margins at launch are high, the oxidizer and fuel tanks are held below operating pressure; the system is locked with a set of valves. Then, when mid-course maneuvers are required, the system is opened using a pyrotechnic valve, and then it is locked up again to protect against regulator leakage. The same operation is repeated again prior to orbit insertion.

Lyman continued, "We opened the valve, and the effect was to go from the cruise pressure of about 74 pounds psi to about 82 pounds. And then, as the day went on, it continued to increase. What we had was a regulator leak. It was a small leak, but at this point in the mission, the oxidizer tank and the fuel tank were almost full, and by putting gas pressure on top of the oxidizer and the fuel, even a small leak would raise the pressure dramatically. If the pressure goes too high you have got a burst disk which vents the pressure overboard, tumbling the spacecraft and preventing you from doing maneuvers."

"What we wanted to do (we being the orbiter folks, the hardware folks, the project system engineer, the director of this thing) was to say, 'Well, that's no problem; we'll just open this valve here (P3) and we'll just close this valve (P4) and when we're ready to do the Mars orbit insertion, we'll open this valve (P5). Simple. But, this turned out to be a difficult 24 hours."

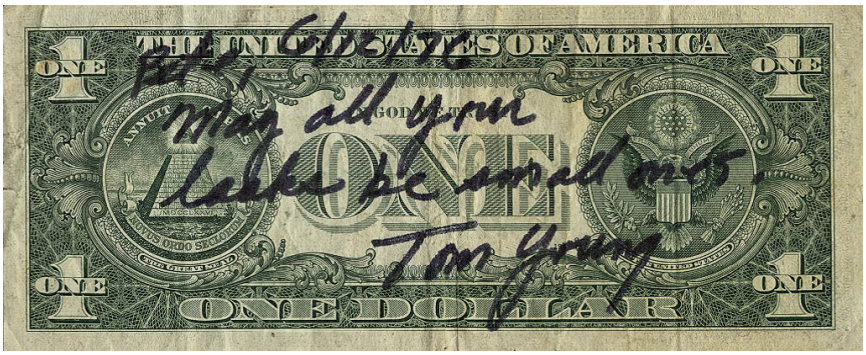


Lyman related that Jim Martin didn't want to risk closing the valve because he feared it wouldn't reopen. The alternative was to relieve pressure by performing a large mid-course maneuver, and a couple of days later, when pressure built up again, do another large maneuver, and then prepare for orbit insertion. A meeting of about 120 people was called, and Jim Martin asked one after another, "What would you do? What would you do? What would you do?" The JPLers were unanimous in favor of opening and closing the valves.

"We had been working since launch," said Lyman, "and we had worked every three-day weekend, because that was the only time that we could get all the computers and the network away from every other project. Basically, we had been working almost 24/7 for a long time. I didn't want to do this in the last few days. The flight path analysis showed a perfect trajectory, and doing these large maneuvers would be *a very big deal*.

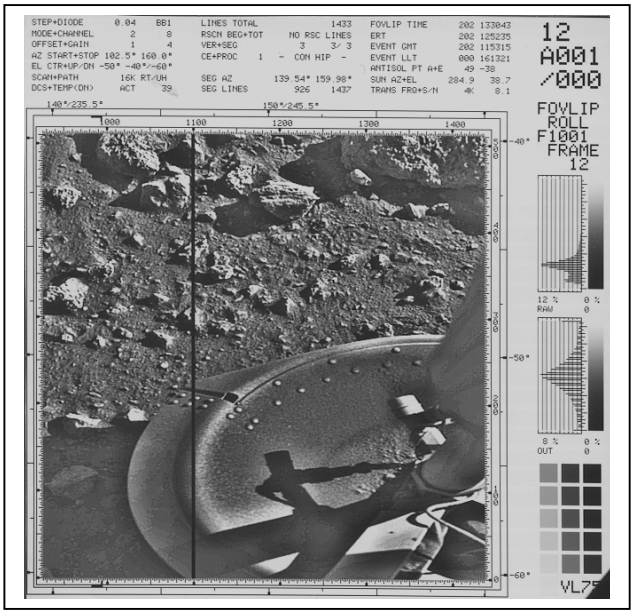
"We took this big vote, and all the Langley folks voted for doing the maneuvers, and all the JPL folks voted for closing the valve. Jim Martin said, 'I'll have to call the Wizards of the East.' That was the term for calling Washington and asking them. Whatever he did with them, he never did tell us what that conversation was. The word came back, 'No, you are not to close the valve; you are to crank up the flight path analysis and do the maneuvers.'

"So, we did it. And it worked. We didn't close the valve. But later in the mission we did, and it worked fine," Lyman shrugged. (More laughter). "Here is a memo from Tom Young."



"May all your leaks be small ones" - Tom Young

"The happiest moment in Viking was obviously when the first picture came back from the surface. The project manager wanted a picture of the lander in the first picture so he could prove that was where it came from. So, here is the leg of the lander." Lyman's audience joined with him in pride and renewed wonder.



Worst Two Weeks

Lyman moved from Viking to Division 36, learning about computers, radiation-hardened chips, slow scanning TV, "and AODCs," which elicited another burst of laughter. "How many of you know what an AODC is? Have we still got any?" Lyman clarified that the Automated Office Data Center was like a personal computer that could also be networked. It was developed at JPL in 1978—the PC was not introduced until 1981.

"When I had taken over Division 36, under very rapid change, I had been told that 'JPL is not in the typewriter business' and to get rid of those things (AODCs). So we had arranged for a contractor to build them. We ordered all the parts through JPL procurement and shipped them out to the contractor's garage in Glendale, and he assembled our AODCs."

Lyman continued, "The worst two weeks I had at the Laboratory had to do with AODCs. It's still hard to imagine, because my career here was fun: I liked coming to work. But one day in a meeting with General Terhune I mentioned that there were 350 AODCs, and for the next two weeks my life was hell. Suddenly, he wanted to know who had each AODC, who used each AODC, where was it located, which software was on each AODC, and what was each program used for on each AODC. I was getting action items every day and was coming and making reports to him. There was a fellow named Harvey Jean, who ran the group in Division 36, and Jeb Long, the software genius. I had those guys and their staff working for those two weeks trying to provide Terhune with all that data.

"I became so frustrated that I was about to put my badge on the table and say, 'Thank you very much, but this place is no longer fun.' Having Terhune upset with you was not fun, and I didn't have a clue about what the problem was.

"At the end of those two weeks, I was slowly riding the elevator in Building 180, up to the ninth floor with another chart for Terhune, and I ran into a fellow in the elevator who ran the office of automated data systems. (This was the office that handled the Reduction of Paperwork Act, written by Congressman Brooks. In those days you had to fill out all this incredible paperwork to buy a computer.) It turned out that Terhune had approved the paperwork for the first 20 AODCs. Meanwhile, this fellow's office had changed the rules for who had to approve AODC buys. All Terhune could remember was that he had said to stop building them, and then I came into his office and told him we had 350.

"By the time I got off the elevator, I knew what was happening. I walked into his office and stood at attention and said, 'Sir, I think I know what the problem is.' And he said, very coolly, 'Well, if you do, why don't you tell me?' And I told him. Later he treated me much more warmly and friendly."

Big Dish

Lyman then transferred to the TDA office, “Those are the guys that run big teams and big dishes. You have probably seen this picture before.”

Deputy Director

“I made one big mistake when I was Deputy,” Lyman admitted. “There weren’t any bookshelves in the office. There was just this crummy looking top-secret military safe left in the office by General Terhune. So I called the carpenter shop and said, ‘Build me some bookshelves and a desk.’ But I didn’t specify very much,” Lyman laughed, shaking his head, “and the carpenter shop took my request as an excuse to go all out.

“There is a fellow named John Casani who works here at the Lab. John is pretty inquisitive; in fact, he is everywhere. He was down in the carpenters’ shop one day and saw this thing and asked, ‘What is this?’ ‘It’s a desk and a bookshelf for the Deputy.’ And wouldn’t you know it...?”

"There is John with a carpenter's uniform on with his name on it, all embroidered. It was my mistake."

Much More...

It was clear that Lyman could regale his audience with stories into the evening, but time drew short. He mentioned some things he got credit for: "No Smoking Policy, No Alcohol Policy, and the 24-hour Fire Department." Then he listed some things he got flak over: "No Smoking Policy, No Alcohol Policy, and the 24-hour Fire Department."

Lyman was also "invited" to roll out the architecture for running the Space Station for 30 years. Although he didn't want to do that, after asking around and paying some visits to Washington and Texas, he came back and decided to do it. "And it paid off," he said.

Lyman shared a few travel memories, too. Once, dressed in Hawaiian garb, after landing at the wrong airport and riding a bus for a day and a half through a snow storm on the East coast to attend a meeting, he arrived at his motel at midnight where a note informed him that things would begin at 6:00. Another time he had to make an 8-hour presentation

because the customer didn't want him to use any of his "slick" presenters. "That was not a fun thing, because being told that the customer doesn't trust the people you trust is not fun." He said his most memorable trip was across eight time zones from Moscow to Vladivostock in the 1980s to learn about Soviet antenna systems.

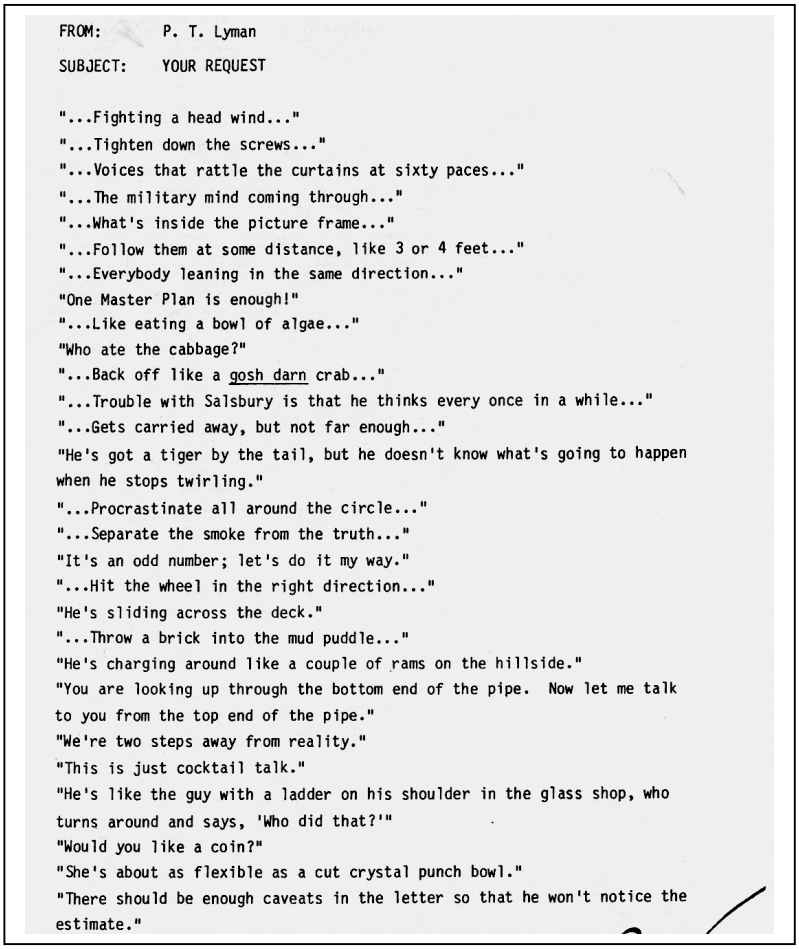
A Final Thought

There was time for one question: "Since we are about to get a new Deputy Director from outside the Lab, what are some of the key things that person should know about the Lab?"

Lyman responded, "My experience with Air Force generals is that they are pretty savvy guys; they don't get to be generals by being hipshooting kinds of guys. I worked closely with General Terhune and I worked closely with General Lew Allen; they were very, very impressive people. This last year I worked for three months with General Ron Fogelman, Air Force Chief of Staff, who, incidentally, doesn't know anything about space—he's a history major. But he knows more about organizations and people than you can imagine—he knows about people interactions. Basically, the Deputy Director is somebody that you want who can understand how the place works and how the people work. General Tattini has a good reputation. I have never met him, but I think he'll do fine."

The Final Word(s)

Pinned to the Library wall: some of General Terhune's "isms!"



FROM: P. T. Lyman

SUBJECT: YOUR REQUEST

"...Fighting a head wind..."
"...Tighten down the screws..."
"...Voices that rattle the curtains at sixty paces..."
"...The military mind coming through..."
"...What's inside the picture frame..."
"...Follow them at some distance, like 3 or 4 feet..."
"...Everybody leaning in the same direction..."
"One Master Plan is enough!"
"...Like eating a bowl of algae..."
"Who ate the cabbage?"
"...Back off like a gosh darn crab..."
"...Trouble with Salsbury is that he thinks every once in a while..."
"...Gets carried away, but not far enough..."
"He's got a tiger by the tail, but he doesn't know what's going to happen when he stops twirling."
"...Procrastinate all around the circle..."
"...Separate the smoke from the truth..."
"It's an odd number; let's do it my way."
"...Hit the wheel in the right direction..."
"He's sliding across the deck."
"...Throw a brick into the mud puddle..."
"He's charging around like a couple of rams on the hillside."
"You are looking up through the bottom end of the pipe. Now let me talk to you from the top end of the pipe."
"We're two steps away from reality."
"This is just cocktail talk."
"He's like the guy with a ladder on his shoulder in the glass shop, who turns around and says, 'Who did that?'"
"Would you like a coin?"
"She's about as flexible as a cut crystal punch bowl."
"There should be enough caveats in the letter so that he won't notice the estimate."

Dr. Peter Tompkins Lyman

Peter Lyman was born on February 9, 1930, in Berkeley, California. After serving seven years in the Merchant Marines, he earned a Bachelor of Science in Mechanical Engineering, a Master's degree of Engineering in Naval Architecture, and in 1963, a Doctorate in Mechanical Engineering, all from the University of California, Berkeley.

Joining JPL in 1963, he worked for 15 years on Mars missions, including Mariner 1964, Mariner 1969, and Viking. He served as Cognizant Engineer for Low-Gain Antenna Dampers for Mariner Mars 1964, Spacecraft Performance Analysis and Control (SPAC) Director for Mariner Mars 1969, and he was Viking's Director of Spaceflight Performance and Flight Path Analysis.

Lyman was Manager of the Spacecraft Design and Integration Section in 1976, Manager of the Applied Mechanics Division (350) from 1976–78, Deputy Manager of Voyager from 1978–79, and Manager of the Information Systems Division (360) from July 1979 to December 1980. In December 1980, he was named Assistant Laboratory Director for Telecommunications and Data Acquisition, serving in that position until June 1987.

On June 30, 1987, Peter Lyman succeeded Bob Parks as JPL Deputy Director. He served in that position until his retirement in June 1992. He has received many awards including NASA's Outstanding Leadership Medal (twice), the NASA Distinguished Service Medal, and the NASA Exceptional Achievement Medal. Lyman is an active community member: he served as President of the Pasadena Chamber of Commerce from 1991–92, and as director of the United Way and the Boy Scouts in the San Gabriel Valley. Hobbies include flying, scuba diving, and restoring steam locomotives.